The Nature Conservancy
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Worldwide Office
4245 North Fairfax Drive
Suite 100
Arlington, Virginia 22203-1606

TEL 703 841-5300
FAX 703 841-1283
nature.org

Statement of Brian Richter
Co-Director, Global Freshwater Initiative
The Nature Conservancy
Before the Committee on Energy and Natural Resources
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Mr. Chairman and members of the Committee, thank you for the opportunity to testify on the SECURE Water Act and strategies to adapt our water management practices for the impacts of climate change. I am Brian Richter, the Co-Director of the Global Freshwater Program for The Nature Conservancy. In addition to providing specific recommendations on the SECURE Water Act, my comments today will focus on three themes:

- impacts of climate change to streamflow, water temperature, and water quality,
- the need to balance human and ecosystem water requirements in the wake of these changes,
- and management strategies to achieve this goal.

The Nature Conservancy is an international, nonprofit organization dedicated to the conservation of biological diversity. Our mission is to preserve the plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive. Our on-the-ground conservation work is carried out in all 50 states and in more than 30 countries and is supported by approximately one million individual members. The Nature Conservancy has protected more than 117 million acres of land and 5,000 miles of river around the world. Our work also includes more than 100 marine conservation projects in 21 countries and 22 U.S. states.

While The Nature Conservancy's mission is focused on sustaining the Earth's diversity of plants and animals, our broader contribution to society is in the protection of the life support systems of our planet – we cannot protect the diversity of life on this planet, including human life, without protecting the ecosystems that sustain us all. Natural ecosystems provide humanity with clean water, food and fiber. Natural resources derived from ecosystems support major sectors of our economy, whether in the form of fisheries that sustain coastal communities or through tourism economies that rely so heavily upon nature-based recreation. Healthy natural ecosystems perform an array of valuable services with substantial economic values, including purifying our water supplies, sequestering carbon, and regulating the climate and hydrologic cycles of our planet, and this work is provided to humanity free of cost.

Climate change is perhaps the greatest long-term threat to the health of aquatic ecosystems that support people, economies, and fish and wildlife. Prompt action to address this threat is critical to minimize future harm to nature and to the social and economic fabric of our communities. While the testimony provided today will focus on adaptation strategies in order to avert the most extreme effects, strong action to address the causes of climate change is essential. The Nature Conservancy is calling for legislation and policies that include three paramount concepts:

- A strong cost-effective cap on emissions and a market-based program designed to stabilize atmospheric greenhouse gas concentrations at a level that ensures the well-being of human communities and ecosystems worldwide. As a member of the U.S. Climate Action Partnership, the Conservancy endorses the coalition's call for specific U.S. emissions reductions to achieve the goal of limiting global atmospheric greenhouse gas concentrations to a level that minimizes large-scale adverse climate change impacts to human populations and the natural environment.[1]

- Reduction of emissions from forest and land-use practices through the incorporation of verified credits from these practices in a cap-and-trade program.

- Support for adaptation programs designed to help ecosystems and the human communities that rely on them to cope with the impacts of climate change.

The principles outlined here recognize that strong measures are needed now to reduce the sources of greenhouse gases that contribute to global climate change, but significant effort is also required to mitigate projected impacts. Uncertainties in future human responses and the persistence of previously emitted gases mean that even with reductions in greenhouse gas emissions, we will continue to feel the effects of climate change for decades to come. We can already see the effects of a changed climate, including increases in global average air and ocean temperatures, increased precipitation in some areas and more frequent and severe droughts in others, and an increase in the occurrence of intense weather events. These impacts are here today, and they are projected to continue and, in many cases, intensify in the future.

It is important for organizations, agencies and individuals to identify strategies and policies to help human communities and ecosystems adapt to a changing climate. We applaud the proactive approach embodied in S. 2156, the SECURE Water Act, that recognizes the need to better understand the impacts climate change will have on the management of our water resources and to prepare strategies now to adapt to these changes.

I. Streamflow

Streamflow patterns rise and fall seasonally with changes in precipitation, evaporation and snowmelt. Flow increases during rainy seasons or as snow melts and declines with the higher temperatures of summer. Freshwater and estuarine plants and wildlife have evolved in concert with and are sustained by the natural variations in water flow that occur seasonally, annually and over the course of many years. Human alterations to natural flow patterns take a serious toll on the plants, animals, and freshwater ecosystems that depend on it. *Environmental flows* are the

[1] The US CAP's Call to Action states

> "We recommend Congress establish a mandatory emission reduction pathway with specific targets that are: between 100–105% of today's levels within five years of rapid enactment; between 90–100% of today's levels within ten years of rapid enactment; between 70–90% of today's levels within fifteen years of rapid enactment. The short- and mid-term targets selected by Congress should be aimed at making it clear to the millions of actors in our economy and to other nations that we are committed to a pathway that will slow, stop and reverse the growth of U.S. emissions. Furthermore, Congress should specify an emission target zone aimed at reducing emissions by 60% to 80% from current levels by 2050."

The Call to Action and more information on US CAP is available at www.us-cap.org.

amount and timing of water flows required to maintain healthy freshwater ecosystems and their benefits to human communities. A well-managed water resource is allocated to people and to environmental flows according to the needs of both.

Climate Change Impacts

Global climate change will exacerbate the changes to natural streamflow patterns already caused by other human influences. The anticipated changes in climate are predicted to happen at an unprecedented rate, challenging any natural adaptation capacity and affecting entire ecosystems. Managing our natural ecosystems to persist during such rapid change will require fundamental changes in our traditional water management approaches. Specifically, water managers will need to fully consider not only the human needs like water supply, hydropower, and recreation that are served by removing water from rivers and lakes, but also the amount of water that must remain in these ecosystems to support wildlife and other human benefits.

> **Recommendation:** Broaden the focus of adaptation strategies in Section 4 of the SECURE Water Act beyond threatened and endangered species and fish and wildlife habitats to protection of ecosystems and specifically the *environmental flow needs* of freshwater ecosystems.

Streamflow in regions across the United States will be affected by climate change in differing ways. Alaska anticipates and is already seeing some of the most profound changes, including increased flooding, especially in ecologically critical coastal wetlands; the thawing of permafrost, which will lead lakes and wetlands to drain in some areas; and earlier Spring peak flows that will cause northern freshwater fisheries, central to local diets, to suffer.[2] Pacific coastal and Rocky Mountain states expect earlier spring peak runoff, more winter flooding and less summer streamflow. Southwestern states are bracing for lower summer flows due to reduced groundwater recharge and for increased flash flooding. Midwestern states may expect more severe droughts and possible steep declines in summer streamflow. The Great Lakes are likely to recede due to reduced tributary streamflow. Northeastern states may contend with large reductions in streamflow and changes in the magnitude and timing of spring floods. Southeastern and Mid-Atlantic states may have lower base flows, larger peak flows and longer droughts. Every region anticipates higher water temperatures, which weaken the ability of freshwater plants and animals to tolerate the other changes in water conditions.[3] And every region is faced with uncertainty regarding the magnitude and timing of climate change impacts.

Climate change impacts to streamflow will severely impair our ability to meet human water needs. Already, competition for limited water resources between irrigators, municipalities, industrial users and hydropower generators has ignited untold conflict in this country. Even water-rich eastern states are mired in "water wars" that we usually associate with the water-strapped western region. Georgia, Alabama and Florida, for example, have involved no less than twelve federal agencies in attempting to resolve long-standing disputes over water allocation in the Apalachicola-Chattahoochee-Flint and Alabama-Coosa-Tallapoosa river basins. Climate-

[2] Arctic Climate Impact Assessment, Impacts of a Warming Arctic, 2004.
[3] http://www.isse.ucar.edu/water_climate/html_map.html (Specific sources for each prediction are fully cited here.)

change induced reductions in water supplies during critical seasons will only exacerbate the competition for water nationwide.

It is critical that providing for these competing demands in the face of climate change does not come at the expense of our natural aquatic systems. The key to providing for all demands efficiently is flexibility to adapt in the face of uncertainty. Healthy natural ecosystems and water-supply systems that are flexible to respond to both short- and long-term changes in streamflow patterns have built-in resiliency to floods, droughts and rising temperatures. And resiliency secures water supplies both for direct human demands and for the healthy aquatic ecosystems that support them.

> **Recommendation**: To ensure that the appropriate balance between healthy natural ecosystems and water supply is achieved, language should be added to the SECURE Water Act to clarify that adaptation strategies developed under The Climate Change Adaptation Program in Section 4 and the Water Management Improvement grants in Section 5 must seek to balance water supply and ecosystem needs while preventing further degradation of aquatic ecosystems.

Adaptation Strategies

Any adaptation strategies implemented at the federal, state or local level must balance human and ecosystem needs for water. Below we offer a number of management approaches that achieve this balance and increase our ability to provide for both humans and ecosystems in the wake of the impacts to streamflow described above.

Comprehensive Water Resource Management

Changes in climate and water availability will present new and complex challenges for water managers. Fortunately, proven approaches for comprehensively managing water resources for humans and nature already exist. But in the vast majority of the country, water managers still lack the basic knowledge of when and where water is physically and legally available in the basins they manage. Despite the availability of sophisticated water accounting tools and methods, very few are actually applied to real-world regional water management in the United States.

Texas leads the nation with its Water Availability Modeling (WAM) system. WAM, which was implemented in 1997 by the Texas Commission on Environmental Quality in collaboration with water users and managers, computes water availability and reliability at 13,000 stream sites within 20 watersheds covering 685,000 square kilometers. By systematically accounting for the cumulative effects of all natural and engineered controls on streamflow, including diversions, return flows and reservoir storage, WAM enables competing demands on each stream segment to be managed efficiently, taking into account both upstream and downstream flow requirements. Through WAM, the state incorporates environmental flow requirements into each new water permit, thus integrating ecological resiliency into statewide water management. Although the

state does not currently consider climate change in its permitting decisions, WAM is a flexible tool with the proven capability of modeling the impacts of climate change on water availability.[4]

The ability to manage water comprehensively over entire basins is fundamental to ensuring flexibility in the overall system and is particularly important in the wake of a changing climate. A key component of comprehensive management is increasing our understanding of water availability, which the SECURE Water Act will help to do by providing support for USGS' national streamflow information program, establishing new monitoring programs, and providing incentives to integrate and standardize water availability data. In addition to gathering the necessary data, it is important that all areas of the country adopt and implement comprehensive approaches to water accounting and management. Therefore, we would support more explicit incentives in this legislation to ensure adoption of comprehensive management approaches by states and localities.

> **Recommendation:** The SECURE Water Act should provide incentives for implementation of comprehensive water accounting and management approaches by explicitly including comprehensive water assessments and management, which includes environmental flows, as a component of the climate change adaptation strategies under Section 4 and water management improvement grants authorized in Section 5.

Demand Management

Equally critical to adaptive, resilient water resource systems is to have water-demand management plans in place for times of drought. Even in water-scarce western states, innovative drought management has successfully averted ecological disaster without threatening senior water rights. The Big Hole basin in Montana is one such stirring example. After nearly a decade of chronic water shortages and ensuing conflicts, state and federal agencies, working together with local stakeholders, have implemented rules for voluntary cutbacks in irrigation diversions and sport fishing, triggered by measured drops in streamflow. Meanwhile, applied hydrologic research has targeted irrigation efficiency measures to specific stream reaches where they most benefit the rest of the basin. Finally, The Nature Conservancy and others are working to improve degraded stream habitat to enable water to move more freely downstream, helping to maintain cool temperatures and good water quality in the otherwise drought-stressed river.

Thus, after years of distrust and debate among ranchers and agencies over irrigation water use, compounded by the threat of federal listing of the imperiled Arctic Grayling fish as an endangered species, and water rights laws that discourage water conservation, the tables are starting to turn. Working together, the people in the Big Hole basin have shown that strategically reducing consumption during periods of drought and restoring stream habitat increases the resiliency of the river and of both the human livelihoods and native species that depend on it. As changes in climate increase the likelihood of drought conditions in parts of the country, states and localities should develop similar demand management plans that enable water users to

[4] Wurbs, Ralph A., Ranjan S. Muttiah, and Fabrice Felden. 2005. Incorporation of climate change in water availability modeling. *Journal of Hydrologic Engineering* 10 (5):375-385; Wurbs RA. 2005. Texas water availability modeling system. *Journal of Water Resources Planning and Management* **131**(4):270-279.

reduce consumption during periods of drought. Federal funding and policy should support these efforts.

> **Recommendation:** The SECURE Water Act should provide incentives for development of demand management plans that protect both human water supplies and ecosystem health by explicitly including demand management plans that incorporate environmental flow needs during droughts as a component of the climate change adaptation strategies under Section 4 and the water management improvement grants authorized in Section 5.

In addition to planning ahead for management during times of drought, it is important that we begin now to reduce our demand on increasingly scarce water resources by implementing proactive water conservation and efficiency practices. We appreciate the focus on water conservation and efficiency in both the development of adaptation strategies and water management improvement grants authorized in this legislation. However, it is often difficult to see a measurable impact from water conservation practices unless they are coordinated on a regional or watershed basis and measured to demonstrate the benefit to the resource. Such an approach should be incorporated into any funding distributed under this legislation for the purpose of reducing consumption or increasing efficiency.

> **Recommendation**: Demand reduction and water efficiency practices funded through the SECURE Water Act should be delivered on a regional or watershed basis and involve measurement of the practices' impact in the delivery area.

Sustainable Water Storage

Historically, society's response to floods and droughts has been to impound surface water in reservoirs and to release it as needed. However, a dearth of geologically suitable locations for new dams, a decrease in the reliability of water available to fill dams, and an increased awareness of their ecological consequences will hinder this response to future hydrologic extremes, even as their frequency and intensity increase. In many areas, an integrated solution can be achieved by managing ground water and surface water together. The legislation's creation of a National Groundwater Resources Monitoring program will provide key data useful for implementing conjunctive management of ground and surface water.

By naturally or artificially recharging excess runoff, depleted aquifers can be transformed into underground "reservoirs" to supplement the flood- and drought-buffering capacity of existing surface-water reservoirs. Existing infrastructure such as irrigation systems can be used to distribute water and recharge aquifers. In addition, wetland ecosystems play a very important role in naturally storing water. By slowing the flow of water, wetlands facilitate the percolation of water into aquifers that can later be used for water supply during dry periods. In light of the environmental consequences and costs of new dams and reservoirs, it is important that this legislation provide incentives for natural and non-structural approaches to water storage, such as artificial aquifer recharge and wetland restoration.

> **Recommendation**: The SECURE Water Act should incorporate incentives for natural water storage such as conjunctive ground and surface water management, artificial

aquifer recharge, and wetland restoration, while minimizing any focus on building new water storage infrastructure.

Another way to increase water storage without building new reservoirs is to increase the capacity of existing dams and manage the stored water in environmentally sensitive ways. One of the most promising ways to improve our use of existing reservoir storage is to reduce our reliance on dams to provide flood control. Presently, a tremendous volume of potential storage space is left empty behind dams because that space is reserved to capture incoming floods and protect downstream structures and roads. If those downstream structures could be moved out of harm's way, and if natural floodplain areas could be restored for the purpose of storing floodwaters, the immense volume of usually-empty flood storage in our nation's reservoirs presently being reserved for flood control can be converted into storing water to supply cities and farms, generating hydro-electric power, and releasing improved environmental flows into downstream ecosystems. Moreover, floods that are allowed to return to their natural floodplains recharge underlying aquifers, which slowly release groundwater back to the river as cool, steady baseflows. Additionally, restoring natural floodplain areas will greatly benefit many plants and animals that have become endangered due to excessive floodplain development.

Through our work on the Yangtze River in China, we have developed a proposal – now under serious consideration by the central Chinese government – that calls for large-scale restoration of the Yangtze valley's floodplain and illustrates the potential benefits of using floodplains instead of dams for flood management. This proposal would enable the flood control volume planned for the new reservoirs on the Yangtze to be reduced substantially and would instead use the available reservoir volume to produce much more hydropower from the Yangtze dams. In fact, we estimate that as much as $1 billion per year of additional revenue could be generated from increased electricity production on the Yangtze River, which in turn would be used to fund floodplain restoration and other non-structural forms of flood management. It will also enable the Chinese to produce badly-needed electricity in a relatively clean manner that does not exacerbate climate change.

We must integrate the role of healthy and functioning floodplains and wetlands into our flood management and not rely solely on dams and reservoirs to meet these needs, particularly as climate change makes the other purposes of these reservoirs even more important. A national assessment should be conducted to identify locations at which the operating purposes of flood control dams can be modified by shifting flood management to floodplains by removing or re-locating roads and structures or by removing or setting back levees that constrain floodplain areas. Further, incentives are needed to both protect and restore wetlands and floodplains, as these valuable areas continue to be lost to urban development or agricultural expansion. By thinking about flood management and water storage in a more comprehensive manner and focusing funding, which may include revenues generated by additional hydropower production or water supply, toward floodplain restoration and flood mitigation below existing dams, aquatic ecosystems, energy customers and water users benefit.

Recommendation: The SECURE Water Act should provide incentives for restoring the natural flood storage capacities of floodplains and wetlands and encourage dam owners and operators to assess the potential for converting the available flood storage volume in

the nation's reservoirs into storage for water supply, power generation, and environmental flow releases. To ensure the ability of natural systems to provide flood reduction benefits, the incentives in this legislation must be coupled with additional strong disincentives for new development in floodplains and wetland areas.

Modifying Dam Operations to Improve Environmental Flows

While the construction and operation of dams and reservoirs has benefited the nation greatly by providing water supply, flood control, and electricity production, dams have also had serious impacts on the health of river ecosystems and are a leading cause of aquatic species endangerment, including many fish species that are of considerable economic value. The hydroelectric power assessment called for in Section 6 of the SECURE Water Act and the adaptation strategies to be developed under Section 4 present an excellent means for identifying ways to modify dam operations to improve downstream environmental flows that will benefit ecosystems made increasingly vulnerable by climate change

The Army Corps of Engineers and Bureau of Reclamation have a critical role to play in maintaining adequate environmental flows. The operating procedures for the hundreds of dams that the Corps and Bureau own and operate seek to optimize inexpensive water, power and flood control, but have largely ignored environmental flow needs downstream of these facilities. The Sustainable Rivers Project, an innovative partnership between the Corps of Engineers and The Nature Conservancy, has already demonstrated at several sites that modest adjustments to existing dam operations can yield substantial improvements in ecosystem health by improving environmental flow releases from the dams, while only minimally affecting other dam functions and keeping operational changes within the project's authorized purposes.[5] Updating operating instructions by specifically incorporating flow releases that benefit the river ecosystem at the nearly two thousand dams under federal control could do a great deal to improve river health and increase resiliency to climate change. Following the example set working with the Corps on the Sustainable Rivers Project, we would support including an evaluation of environmental flow needs in the assessment of hydroelectric power dams required in Section 6 of the legislation

Recommendation: The SECURE Water Act should include evaluation of environmental flow needs in response to climate change as a component of the hydroelectric power assessment to be conducted by the Secretary of Energy under Section 6 of the Act and the development of adaptation strategies under Section 4.

II. Water Temperature

Climate Change Impacts

In addition to the effects discussed above, climate change will also cause a rise in water temperatures. Water temperature plays a crucial role in the health of river and stream ecosystems. The distribution of aquatic species and their growth and reproduction rates are determined, in large part, by water temperature. Stream temperatures are projected to rise 0.9° C

[5] Postel S, Richter B. 2003. *Rivers for Life: Managing Water for People and Nature*. Washington, D.C.: Island Press, p. 92-102

for each 1° C rise in air temperature.[6] In some places, water temperatures have already reached the lethal limits for some fish species. A recent analysis projects that thermally suitable habitat for 57 species of cool- and cold-water fish will decline by 50 percent in U.S. rivers if air temperatures rise by 4° C.[7]

Adaptation Strategies

As water temperatures rise, the survival of many aquatic species may depend on stream connectivity and their ability to migrate upstream or in a northerly direction to cooler waters. Access to suitable migration corridors is necessary for this movement to succeed.[8] Across the nation, state agencies and private conservation groups are seeking to improve stream connectivity by actively removing old, unused dams that block fish migration. Allowing these fish to migrate to higher elevations and latitudes as temperatures increase may be the key to their surviving climate change. Similarly, road culverts that pose impediments to fish movements are being replaced with fish-friendly structures.

> **Recommendation**: Water Management Improvement grants under Section 5 of the SECURE Water Act should include funding for activities to improve stream connectivity, which will enable the removal of unnecessary dams, replacement of inadequate road culverts with fish-friendly structures, and incorporation of improved drainage structures into new construction.

III. Water Quality

Climate Change Impacts

Climate change will adversely affect water quality in some regions of the U.S. by altering water temperature, dissolved oxygen levels, salinity, and assimilative capacity for point and non-point source pollutants. There is an inverse relationship between water temperature and dissolved oxygen levels, which plays a critical role in the health of aquatic ecosystems. As water temperatures rise, dissolved oxygen levels will decrease. Pollution, in addition to temperature, also influences dissolved oxygen levels; when increased organic matter flows into water systems dissolved oxygen levels decrease as bacteria and other organisms consume oxygen while working to break down the organic matter.[9] So, ecosystems currently under stress from pollution levels will see increased stress as water temperatures rise from climate change.

As discussed earlier, some regions in the U.S. will see decreased streamflow due to changes in precipitation patterns caused by climate change. In some areas, decreased streamflow can lead to

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[6] Schindler, D.W. 1997. Widespread effects of climate warming on freshwater ecosystems in North America. Hydrol Proc.

[7] Poff, N. L., M. Brinson, and J. B. Day. 2002. Freshwater and coastal ecosystems and global climate change: a review of projected impacts for the United States. Pew Center on Global Climate Change, Arlington, VA.

[8] Poff, N. L., M. Brinson, and J. B. Day. 2002. Freshwater and coastal ecosystems and global climate change: a review of projected impacts for the United States. Pew Center on Global Climate Change, Arlington, VA.

[9] National Estuarine Research Reserve System, NOAA, www.nerrs.noaa.gov/Monitoring/WaterOxygen.html

increased water salinity. One such example is Southern New Mexico. There the Rio Grande picks up water on its journey south from upwellings of salt concentrated spring waters. With less streamflow and runoff to dilute the water, the river will become more saline causing problems for water users in the area such as farmers who use the water for irrigation.[10]

Finally, with reduced streamflow, the assimilative capacity for point and non-point source pollutants is lowered. Using again the example of the Rio Grande watershed in New Mexico, Brian Hurd of New Mexico State University and Julie Coonrod of the University of New Mexico point out that with less water, in non-attainment reaches of the Rio Grande, lower total maximum daily loads (TMDLs) might be expected and this could raise control costs. Additionally, new reaches of the river may fall out of attainment causing higher pollution control costs.[11]

Adaptation Strategies

Climate change will exacerbate existing water quality impairments. To respond it is important that we both continue and give renewed focus to current efforts to address these water quality issues. Further, many of the strategies described above to better manage water in the wake of climate change will help to mitigate the expected impacts to water quality.

IV. Climate Change Adaptation Research

All of the straegies outlined above will prove useful as water managers respond to climate change. However, we must continue to conduct research to better understand the climate impacts and necessary responses in specific places. Scientists at the Conservancy are actively monitoring climate change impacts around the world to better understand climate change and how wildlife and ecosystems may adapt. With a growing understanding of present and future scenarios, we will be better equipped to help water managers and the ecosystems affected by our management cope with warming, changes in precipitation and other impacts of climate change.

Over the course of the past 12 months, The Nature Conservancy in New Mexico has initiated a state-wide climate change vulnerability assessment and adaptive management program which we hope will serve as a blueprint for other states and regions. The primary goals of this program is to provide specific science-based information on the current and projected impacts of climate change on wildlife habitats, and to work with key land managers and conservation practitioners to collaboratively design and implement adaptive management strategies and actions.

The project currently includes three core components: (1) analysis of recent changes in climate, hydrology, and ecology and how these relate to priority conservation areas and target species (as identified in TNC's ecoregional analyses and the New Mexico Comprehensive Wildlife Conservation Strategy), (2) assessment of potential changes in the target species and ecosystem distribution under a suite of future climate change scenarios and projection of implications for the priority conservation areas, and (3) identification of adaptation strategies that managers can

[10] Hurd, B., Coonrod, J., Climate Change and Its Implications for New Mexico's Water Resources and Economic Opportunities, July 2007.
[11] ibid

use to promote ecological resilience that will ultimately facilitate the conservation of biodiversity and associated ecosystem services.

Climate change will alter landscapes, rivers, streams and seascapes as we know them. It is important that we build our adaptation strategies on sound science and seek to ensure that approaches to address the consequences of a changing water supply balance the need to protect our aquatic ecosystems. Projects such as the Conservancy's climate adaptation program in New Mexico will help us analyze the impacts of climate change on plants, animals and natural communities and will help to create innovative conservation solutions that will enable humans and natural areas to cope with and adapt to what may be the unavoidable effects of climate change. Therefore, we recommend that the SECURE Water Act take a similar approach by using scientific input on climate adaptation in the development of the adaptation strategies and linking the implementation of adaptation activities to the science-based strategies being developed by the Department of Interior.

> **Recommendation**: The development of adaptation strategies in Section 4 of the SECURE Water Act should be based on scientific input regarding climate change impact to water supply and aquatic ecosystems. In addition, the Water Management Improvement grants in Section 5 should be linked to the science-based adaptation strategies developed in Section 4.

V. Conclusion

The impacts of climate change on freshwater systems will be profound. Water flows in rivers will be altered, incidents of flooding and droughts will increase, water temperature will rise, and water quality will be degraded. Failing to protect freshwater ecosystems from these changes will have tangible societal, cultural and economic consequences, putting great pressure on our water managers. Our response to climate change must recognize the role that healthy ecosystems can play in mitigating these impacts to both humans and natural communities. It is important that all of our policy and on-the-ground adaptation approaches recognize the need to maintain healthy and resilient ecosystems that preserve the ability to adapt in the face of climate change and continue to meet the needs of both humans and wildlife.

In order to enable aquatic ecosystems to provide for human and wildlife needs in the face of a changing climate we must:

- Design water-supply systems that are flexible to both short- and long-term changes in streamflow patterns including increased floods, droughts and rising temperatures. Specifically, states and localities should develop demand-management plans that enable water users to reduce consumption during periods of drought. Federal funding and policies should support these efforts.
- Adopt comprehensive basin-wide approaches to water accounting and management to preserve the flexibility of the water system to adapt to change – all water management plans should give due consideration to environmental flows needed to sustain healthy freshwater ecosystems. This includes acquisition and coordination of data on water availability that will be necessary to inform comprehensive management.

- Manage existing water infrastructure in a manner that both meets human needs for water and sustains healthy freshwater ecosystems. This includes providing appropriate environmental flow releases from dams.
- Restore floodplains and wetlands that can provide needed flood storage and help to recharge aquifers, while freeing up valuable storage space previously allocated to flood control. The reservoir volume made available by non-structural flood management downstream of dams can be used for improved water supply, electricity production, and environmental flow releases.
- Remove barriers that constrain the ability of fish and other aquatic organisms to move to cooler waters as the climate warms. Unnecessary dams and road culverts that block aquatic organisms from migrating should be removed or replaced.
- Invest in applied research on the impacts of climate change on specific ecosystems and link adaptation strategies to this research.

We believe the SECURE Water Act is an important first step in addressing many of the impacts climate change will have on our water resources. We look forward to working with the committee to incorporate the principles above into this legislation.

Thank you again for this opportunity to testify and to comment on this important legislation.